STERILITY and DELAYED BREEDING in DAIRY CATTLE

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Contents

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STERILITY and DELAYED BREEDING in DAIRY CATTLE

S. A. ASDELL and H. J. BEARDEN

Sterility and delayed breeding in dairy cattle are two problems that are causing increased concern among dairymen. It is estimated that in New York State alone the losses in time, value of products, and in decreased value of stock from sterility and delayed breeding amount to about $20,000,000 each year, and the losses seem to be increasing. Whether the losses are actually increasing or whether dairymen are just more conscious of their loss when a cow fails to breed on time is not clear. They may be more conscious of this loss because gradual improvements in feeding and nutrition have increased average milk yield and subsequently the value of the cow.

Many persons think of sterility as a single problem to be eliminated by the wave of a magic wand when the research scientist has found the material from which the wand must be manufactured. This is far from the truth. Sterility is not a disease in the sense that measles or blackleg is a disease. It is a symptom—one that accompanies many diseases just as fever is a symptom that accompanies a variety of diseases. Fever can be reduced by taking proper measures, but it cannot be eliminated unless the cause is found and cured. It is the same with sterility. Unless the cause is removed, and there are many causes, complete reproductive health cannot be restored. To carry the comparison further, fever, when it becomes too high, results in death. Similarly, infertility in its extreme results in sterility or total inability to produce a calf. There are all degrees between complete fertility and complete sterility.

These problems have engaged the attention of workers at Cornell University Agricultural Experiment Station and at the New York State Veterinary College for many years. Work has also been going on at other colleges and experiment stations throughout the world. That any universal cures have not been found shows the difficulty and complexity of the problems. Three important facts have come from all of this work:

Each cow is a separate case and should be treated accordingly. The cow

can no more be treated on a "mail-order" basis than can a human. In both cases the doctor must see the patient.

Early treatment is important. If the veterinarian is called at the first signs of trouble, he and nature are able to do a far better job than they can if the case is left too long. Early treatment saves time and may prevent the trouble from going too far or from spreading to other cows. A cure gives satisfaction to the owner and to the veterinarian.

Means of prevention must be studied. Prevention has proved to be the best way to combat Brucellosis, or contagious abortion, and such a means of attack is worth considering in other conditions leading to infertility.

WORK WITH THE VETERINARIAN

A close working relationship between the dairyman and his veterinarian often stops trouble before it becomes serious. For example, cows that have experienced difficulties such as retained afterbirth at calving time, should be checked before they are bred again. Cows showing abnormal discharges and those that have not been in heat within 50 to 60 days after calving also should be checked and treated if necessary. Some veterinarians and interested dairymen are going a step further in examining all cows between 40 and 60 days after calving and before breeding as a prevention of trouble. Early diagnosis is vital in correcting most problems.

SOME FACTORS INVOLVED IN STERILITY

The reproductive tracts of the cow and bull are complex structures. They serve to bring the sperm and the egg together to start a new life, and also to hold and nourish the fertilized egg for nine months while it grows from a single cell with a simple structure to a calf weighing about a hundred pounds with all its organs fully formed and functional. It is no wonder, then, that things go wrong occasionally; the wonder is that a normal calf ever is born. As a matter of fact, every possible mishap does occur at some time or other and the possibilities are many.

In many respects the cow is unique among animals in her reproductive processes.[1] On the average she sheds her egg about 12 hours after she is out of heat; In other animals, heat usually is terminated by the shedding of the egg. The cow frequently bleeds from the uterus about twenty-four hours after the egg is shed; she has a somewhat long interval between heats for an animal with her type of reproductive cycle; she works at an

[1]The structure of the reproductive tracts of dairy cattle and the manner of their working has been outlined in Cornell Extension Bulletin E-305, *The Reproduction of Farm Animals*, by S. A. Asdell and H. J. Bearden. The material presented there is not repeated here except where it is necessary.

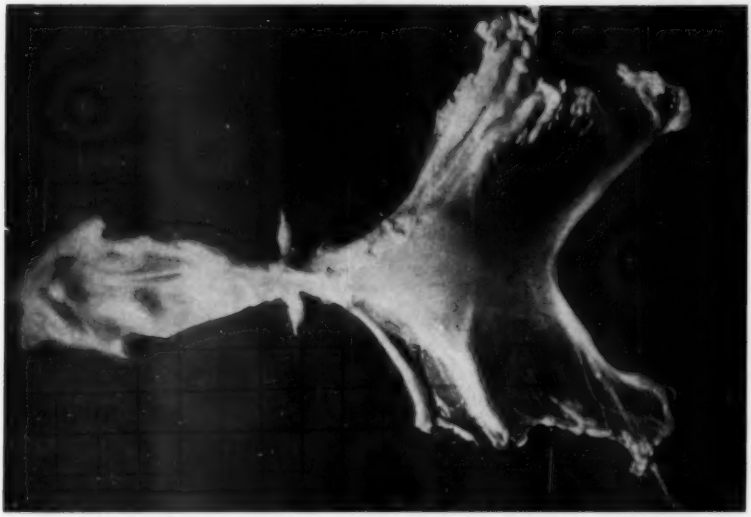

Figure 1. Reproductive organs from a freemartin heifer. This may be contrasted with normal reproductive organs seen in figure 4.

exceptionally low level of hormones (chemical substances which coordinate the varying activities of the reproductive tract); and she produces freemartins. Some of these characteristics help in the attempts to bring her reproduction under control; others hinder them. It is only by learning how the processes work and how the delicate adjustments of timing and development are brought about that one can hope to improve the overall efficiency of reproduction.

Some of the things that may go wrong in the breeding processes and the remedy, if any, for each are discussed in the following pages. It must be emphasized at the outset that sterility is not always the result of one condition but may be a combination of several which, together, are just too much for efficient reproduction to take place.

In general, far less is known about reproductive disorders in the bull than in the cow and they have proved even more difficult to remedy.

STRUCTURAL DEFECTS

The freemartin

The freemartin, an anomaly that has been known since time immemorial, results in complete sterility and nothing can be done about it. The condition is present in females that are twin to males. If both twins are

bulls or both are heifers, they are no more likely to be infertile than are singles. Freemartins are females that have had the formation of their reproductive organs upset. See figure 1. The condition is unknown in other animal species except for a partial freemartin condition that has been described in swine. Because it occurs only in the female of mixed twins, an average of one twin in each four born may be a freemartin. Six percent of the heifers born co-twin to bulls are normal, but the remaining 94 percent are freemartins and therefore sterile.

Externally the freemartin looks like a heifer calf, but the genital opening may be smaller than usual. If this is so, it is useless to keep the calf for breeding. As a test, an ordinary wood pencil can be introduced, eraser end first, into the vagina. If it penetrates only a short distance, as compared with the degree of penetration into the vagina of a normal heifer calf, the animal is a freemartin. As she grows older she usually develops a long tuft of hair in the region of the vulva and takes on the conformation of a steer. Internally the sex organs are very small and testicle-like in appearance, but they do not produce sperm. The uterus is usually represented by two very thin bands of tissue, and the vagina is very small and short. The condition is much like that found in early embryonic life. Something, probably resulting from the cross-blood circulation between the twins, is believed to come from the male twin and arrest the sexual development of the heifer, altering it towards the male.

Hermaphroditism

Hermaphroditism is a rare anomaly in cattle, and consists of a mixture of the organs of both sexes in one animal. Two types have been observed. One is true hermaphroditism in which ovaries and testicles are present in the same animal with a mixture of other sex organs. The other is pseudo-hermaphroditism in which testicles are present, usually undescended, but development of the penis is imperfect. Needless to say, animals of both types are sterile.

Other inborn structural anomalies

Occasionally cattle have incomplete oviducts, mal-formed uteri, blind cervices, blind vaginas, and the like (see figure 2). Usually these defects cannot be repaired. The heifers come in heat regularly because the ovaries are functional, but the defects prevent the sperm and eggs from meeting; therefore such animals are sterile from the outset. There is no doubt that certain of these defects are inherited and if they are present the conditions occur more frequently if inbreeding is practiced. In fact, these conditions

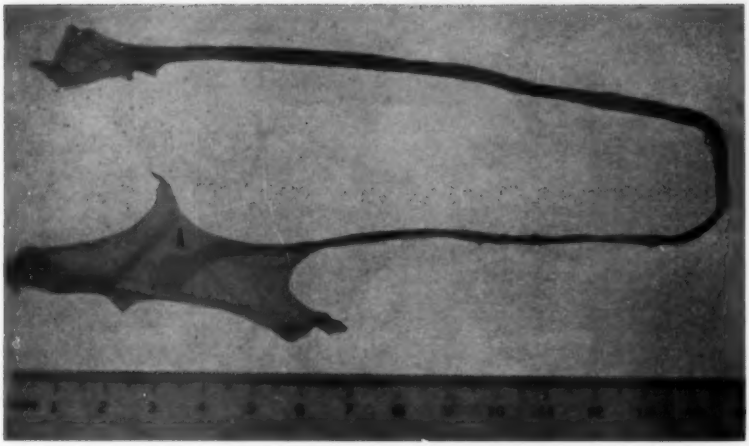

Figure 2. Incomplete oviduct from a two-year-old heifer. Note the gap between the two parts at point A.

often are not suspected until they are uncovered by inbreeding.

Bulls may have similar abnormalities. Most frequently they take the form of incomplete union of the testicles with the ducts that conduct the spermatozoa or of malformations of the penis. This condition prevents complete service.

Undescended testicles. Bulls in which both testicles remain in the body cavity have all the male characteristics but they are sterile because spermatozoa cannot be formed at the higher temperature that prevails in the body as compared with that in the scrotum. The condition may arise because the ligaments that connect the testicles with the body wall are too short or because the passage through which the testicles descend to the scrotum is too narrow. Usually the condition cannot be remedied. When one testicle remains in the body, the other one in the scrotum is able to produce spermatozoa and the bull is usually fertile. He should not, however, be used for breeding since the condition is inherited and the effects are cumulative. Extensive use of a bull of this sort may produce a large number of progeny that retain both testicles. Use of normal bulls will tend to breed the condition out of a family. Bulls raised for breeding purposes should be checked early for this condition. If it exists the bull should be butchered and not raised.

Infantile ovaries. A fairly frequent cause of infertility in heifers is the failure of the ovaries to develop and produce eggs. The condition is char-

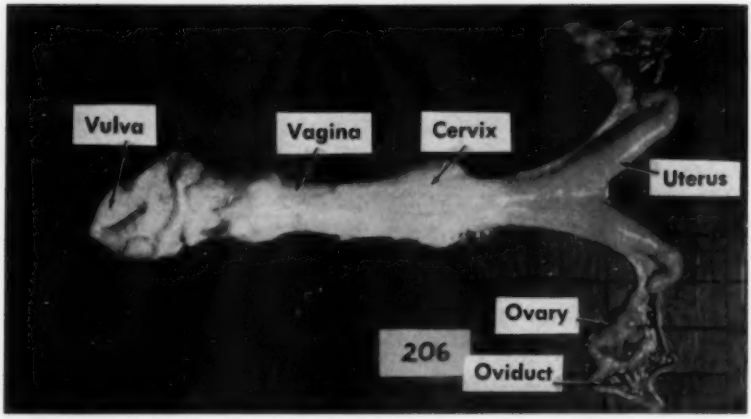

Figure 3. Infantile reproductive tract from a two-year-old heifer. Note small uterine horns and ovaries compared with those of normal heifer in figure 4.

acterized by absence of heat periods and lack of growth of the uterus and the vagina. It is more frequently found in underdeveloped heifers than in those which have grown well. Figure 3 shows the reproductive organs from a two-year-old heifer that was underfed. Sometimes these organs develop if the heifer is kept on good pasture during the spring months. If the condition occurs in the winter it can usually be overcome by feeding the heifer liberally on a good grain mixture containing 16 percent protein. The injection of hormones has sometimes proved effective. One or more injections of a gonadotrophin (pregnant mares' serum) is often helpful.

A similar condition in bulls in which spermatozoa are not produced has not yielded to treatment in the vast majority of cases.

Injuries

In addition to these inborn defects of the reproductive tract, the internal organs of the cow may have been injured in some way. An unduly large or too vigorous bull may rupture the vaginal wall. Similar conditions may be produced by ill-treatment, either deliberate or accidental. Sometimes there has been extensive injury during birth, an example of this is shown in figure 5. Such injuries may prevent or materially impair the chances of further successful reproduction and they should be taken into account in studies of reproductive health.

Similarly, the organs of the bull may be injured. Perforating wounds

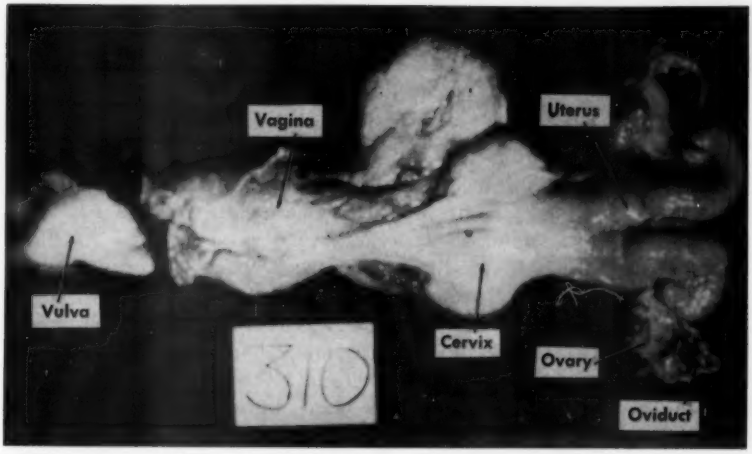

Figure 4. Normal reproductive tract from two-year-old heifer.

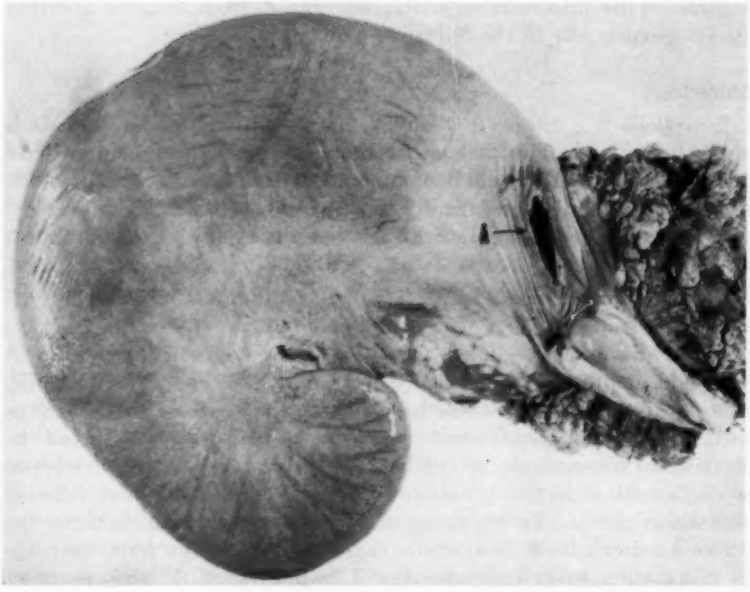

Figure 5. Uterus which was torn during the act of parturition (birth). Note point A.

of the scrotum or of the sheath may, in themselves, set up inflammation, or they may lead to the introduction of harmful bacteria that can produce inflammatory conditions.

SOME DISEASES OF THE REPRODUCTIVE ORGANS

One of the most troublesome disorders of reproduction is abortion. This is troublesome both in itself and in that it may cause unusual conditions, such as retained placenta and the presence of dead tissue. The latter may be a breeding ground for bacteria that will produce further harmful effects. Abortion may be produced by a variety of micro-organisms or it may result from accident. Rough treatment, undue exertion, and fright, all take their toll of developing calves. A placid, contented cow is more likely to carry her calf safely during pregnancy than is one that is roughly handled or kept in a state of nervous tension. When, however, there is an outbreak of abortion in a herd it is safest, until proved otherwise, to assume that some form of contagious abortion is the cause and to act accordingly. The animals should be isolated and their cleanings and bedding destroyed. They should not be served by a bull used on clean members of the herd, because the infection may be spread through him.

Some of the infections or contagious conditions that cause abortion are reviewed briefly in the following paragraphs.

Brucellosis

Brucellosis is a disease that causes abortions in cattle. The disease is also transmitted to humans and for that reason health regulations have been imposed which make it mandatory to control this disease. Therefore, the amount of breeding difficulty caused by Brucellosis has diminished greatly in New York State. In herds where it does still exist, however, it is a real problem.

Control Measures. The best means of controlling any disease is to prevent it. Fortunately, in the case of Brucellosis, a vaccine that confers immunity has been developed. Calves should be vaccinated between four and eight months of age (see figure 6). In most cases this gives them lifetime protection against the disease. A blood agglutination test can be used to diagnose the disease, and animals positive to it should be slaughtered immediately. Recently, a milk ring test has been developed to check milk at receiving stations. This test locates herds with infected animals in them. The blood test then has to be used to pick out the infected animals from these herds. This test is playing an important role in eliminating Brucellosis and it will help to keep the disease under control in the years ahead.

Figure 6. This calf is being vaccinated for Brucellosis. The vaccine furnishes lifetime protection in most cases.

Vibriosis

Many abortions are the result of infection with a bacillus called *Vibrio fetus*. This was first recognized in England in 1913 and in the United States in 1918 by Theobald Smith. The bacillus is a small comma-shaped or S-shaped organism, and its action is similar to that of *B. abortus* because both interfere with the blood circulation in the placenta. Most of the abortions caused by vibriosis occur during the first few weeks after conception. The developing calf and membranes are reabsorbed, or discharged without their being noticed because of their minute size. About ten percent of the infected cows show noticeable abortions. These are most frequent at the fifth month of pregnancy.

Like trichomoniasis, vibriosis is a true venereal disease because it is transmitted almost exclusively by mating. The organism lives within the sheath surrounding the bull's penis. The bull may remain infected all his life, and it is difficult to rid him of all possibility of infecting cows. Heifers seem to be especially susceptible to infection. Two groups of heifers (one containing nine and the other ten) were infected with vibriosis in an experiment conducted by the New York State Veterinary College. The

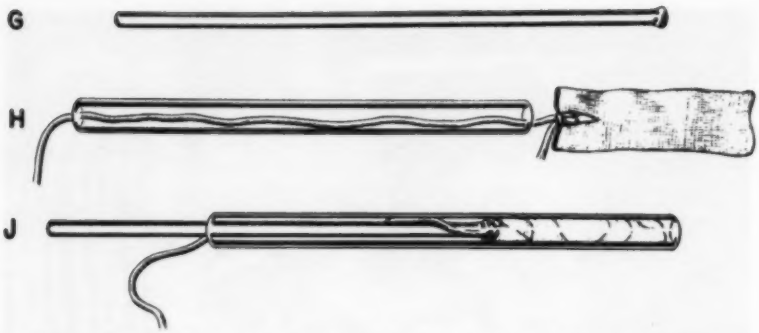

Figure 7. Equipment used in taking mucus sample for Vibriosis mucus agglutination test for the diagnosis of this disease. G—glass rod. H—glass speculum with gauze tampon and string. J—assembled equipment.

heifers required a median of five (range one to sixteen) services per pregnancy. Thirteen of the 19 heifers experienced abnormally long heat periods ranging from 27 to 53 (median 32) days in length. The mucus discharges that occurred during estrus were usually cloudy in recently infected heifers, but they cleared up before pregnancy was established.

The delay in getting animals settled is expensive and represents the major cause of loss from this disease. If vibriosis is suspected in a herd, a diagnosis may be made. Your veterinarian can obtain a tampon sampling kit from the New York State Veterinary College for this purpose. The sampling equipment is shown in figure 7. Mucus samples are then taken from six or more suspected cows and sent back to the Veterinary College. An agglutination test is made on the mucus samples. This test has proven very reliable as a herd test, but it has not proved to be sufficiently accurate to identify infected animals.

Prevention. In an experiment conducted by New York State Veterinary College, 94 heifers were inseminated with antibiotic-treated semen from infected bulls. Vibriosis did not develop in any of these heifers. Fortunately, spread of the disease is easily prevented by employing artificial breeding, using semen treated with certain antibiotics. It is now standard practice for all artificial breeding organizations to add these to the semen diluters. A mixture commonly used contains 500 units of penicillin and 500 micrograms of streptomycin per milliliter of the diluted semen.

Trichomoniasis

Trichomoniasis, which occasionally causes abortion, is produced by a protozoan called *Trichomonas fetus*. This is a small organism with whip-like flagella that are used as organs of locomotion. A diagrammatic drawing of one is shown in figure 8. Trichomoniasis was first described in France in 1888, but not until 1925 was its virulent nature recognized. By 1932 further research work left no doubt of its wide distribution in this country. One of the main difficulties in recognizing its existence is that of finding the organism when it is present in small numbers.

The trichomonad lives in the uterus of the cow and within the sheath of the bull. Infection is spread to clean animals of either sex by mating with an infected animal; therefore, transmission through a herd may be rapid. In the uterus, the organism causes an inflammation of the wall which produces a discharge. This prevents conception from occurring readily, but it does not interfere to any marked degree with the regularity of the estrous cycles prior to breeding. The disease should be suspected, if, in a herd, irregular heat cycles are evident after the cows are bred. Periods of one to three months without heat are common. Many such irregularities may be the result of undetected abortions. In these respects the symptoms resemble those of vibriosis. If abortion follows a conception, it usually occurs from one to sixteen weeks after the last breeding. Early abortion is one of the main characteristics of the disease. Abortion may be complete, with discharge of the membranes; it may be incomplete, with retention of the membranes that serve as a breeding place for the trichomonads and which then produce a flaky pus; or the fetus may die and the yellow body in the ovary may persist. If the latter occurs, the uterine seal remains intact, the fetus becomes macerated, and pus accumulates in the uterus because it cannot escape through the

Figure 8. Sketch of a trichomonad. The actual size of the organism is about one fifteen-hundredth of an inch long.

cervix. Several gallons of this fluid may accumulate and the continued increase in the size of the cow may make it appear that pregnancy is continuing. When the cervical seal is broken on examination, the dammed up fluid escapes but further conceptions are unlikely because the wall of the uterus has been eroded too much for a successful implantation.

Prevention. So far protective vaccines or blood tests for diagnostic purposes have not been successful enough to warrant their use. The best method of control is one that aims to reduce the possibility of infection. Infected bulls should never be used, and clean bulls should never be mated with infected cows or cows that have ever been bred to an infected bull. Suspected cows should be bred only by artificial insemination. Semen from infected bulls may carry the infection; because antibiotics do not kill the organisms, it is not advisable to use these animals for any purpose. Curing the disease is a difficult job. A treatment has been worked out for bulls, but it is a long slow process, and it is difficult to decide whether a bull has been freed from the disease. It is necessary to breed a number of virgin heifers to the bull and then to test them for the disease.

Leptospirosis

Leptospirosis, a disease caused by the microorganism *Leptospira pomona*, is not primarily a reproductive disease; however, it does cause a high percentage of infected cows to abort if they are in the latter stage of pregnancy at the onset of the disease. It spreads very readily from one animal to others in a herd. Apparently it is not transmitted through the semen in artificial insemination. The general symptoms in infected animals are high body temperature, loss of appetite, reduced production, milk that is sometimes thick and yellowish in color, and urine that may have a tinge of blood in it. These general symptoms do not always occur. When the disease is suspected, blood samples should be taken by your veterinarian and sent to the New York State Veterinary College at Cornell University for a laboratory diagnosis.

Originally the abortions produced by leptospirosis were thought to be caused by the high body temperature of the infected cow. Recent research from Denmark, however, indicates that the disease organisms attack the placenta and fetus, thus causing the abortion. Additional research must be done before the question is definitely answered.

Prevention. A vaccine that gives protection for nine to twelve months has been developed for Leptospirosis. Vaccination is recommended when:

1. An outbreak occurs in your herd.
2. An outbreak occurs in a neighboring herd.

3. New animals are being brought into the herd.
4. Animals are to be shown. These should be vaccinated at least two weeks before they leave the herd.

Sick animals should be isolated as soon as possible.

Other causes of abortion

Isolated outbreaks of abortion have been traced to other causative organisms, but none of these appear to be important. Experimental work at Cornell and elsewhere indicates that many cows are irregular in their heat periods because they have early undetected abortions. An examination of the uterus shows that some organisms of a pus-forming type have damaged the lining. The usual attachment of the fetal placenta to the uterine wall, which is of the snap-fastener type, is insufficiently firm and the calf slips out at an early stage of development.

If a cow fails to clean properly after calving and dead tissue is left in the uterus, this tissue provides a good breeding ground for many organisms not specific for the reproductive tract, but of kinds that may be found in any suppurating wound. Infections of this sort may impair the reproductive processes by the erosion they cause. Severely damaged cotyledons cannot be replaced, and the injury is permanent. At the first sign of an unhealthy discharge, call a veterinarian so the cause can be removed. A normal discharge is clear and transparent. Any discolored discharge or one that contains flakes of white, grayish or yellowish color should be regarded with suspicion. If the afterbirth does not come away within 48 hours after calving, help should be obtained.

FUNCTIONAL CAUSES

The chronic buller

Some cows are in heat all the time, or return to the bull much more frequently than the usual 21-day interval. This condition is called "nymphomania," or cystic ovaries, and is the result of the persistence of the ovisac (or graafian follicle) on the ovary. This structure, which contains the egg, usually ruptures about 12 hours after the end of heat. Because it secretes the hormones (estrogens) that cause heat, the cow remains in heat if it does not break. An example of this is shown in figure 9. Its cause is unknown, although the fact that it is often accompanied by an inflamed uterus may be significant, pointing to an irritation of the uterine lining. If this view is correct, a vicious cycle is set up; the uterus acts upon the ovary and the ovarian secretion, in turn, unduly stimulates the uterus.

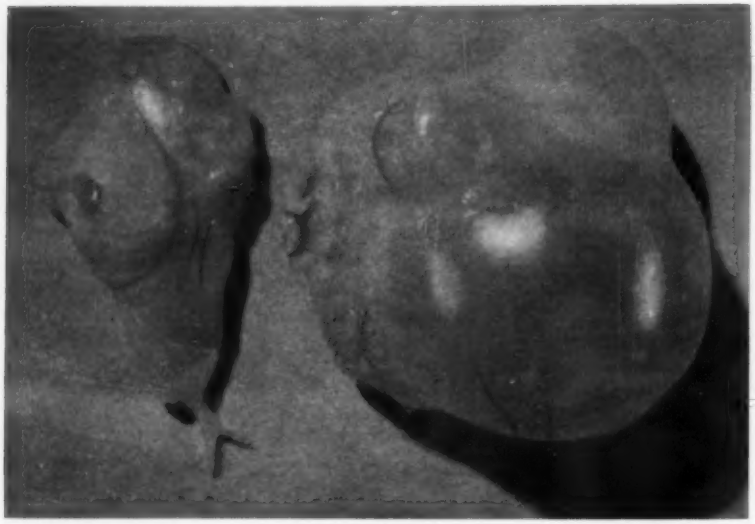

Figure 9. Ovaries from a two-year-old heifer. The one on the right has one large follicular cyst and two smaller ones. The ovary on the left is about normal in size.

The cycle may sometimes be broken by the injection of chorionic gonadotrophin hormone by a veterinarian. This hormone causes the cyst to disappear and allows the cow to revert to a normal heat period. The manual rupturing of the cyst through the rectal wall by a qualified veterinarian has also proved effective in some cases, especially in those where one or two large cysts are present on the ovary. This procedure is not without danger since the funnel shaped opening into the oviduct may be injured and the adhesions that follow may close the oviduct, making it impossible for an egg to travel down to the uterus. Complete sterility has resulted from such practices. About 50 percent of the treated cows conceive to the first service when they are bred at the first heat period after treatment. Neither of the above treatments is completely effective, but both are usually more effective when they are administered early.

Absence of heat

Absence of heat may result from a variety of causes. The cow may be pregnant. She should first be examined for this possibility.

In the mature cow that has had one or more calves, absence of heat usually means that one of the ovaries contains a yellow body. These bodies normally persist throughout pregnancy. Furthermore, they play a part in regulating the spaces between heats. There are no heat periods when a fully functional yellow body is present. Yellow bodies that persist beyond their usual time probably do so because of the presence of fluid or fragments of placenta in the uterus. This prevents the yellow body from regressing in the usual way, heat is prevented, and the cow cannot be bred until one or the other is removed. The yellow body can best be removed by the injection of a gonadotrophic hormone preparation. The veterinarian may remove them by squeezing them from the ovary and allowing them to drop into the body cavity. The operation is not without risk because the bleeding from the ovary is sometimes excessive. There is also danger of causing adhesions that interfere with conception. Like the condition of the chronic buller, the uterine lining is often inflamed when there is a persistent yellow body. The irritation in the uterus may resemble that caused by a developing fetus, and an ovarian condition like that found during pregnancy may result. The cow usually comes in heat about four days after the yellow body is removed.

Another cause of persistent yellow body is the presence of a mummified calf in the uterus.

Before it is decided that a persistent yellow body is the cause of the absence of heats, the possibility of "silent heat" should be checked. This condition occurs more frequently than has been realized in the past. The cow ovulates normally but without the usual excitement of heat so that the event goes unrecognized. There is also the possibility of an unobserved normal heat period. Closer examination of the cow than she is usually given is needed to find out when to breed her. If blood is seen on the vulva or tail she should be carefully watched for signs of heat about 18 days later.

Sometimes the absence of heat results from insufficient activity in the ovaries because of poor nutrition or disease. Young heifers may fail to come in heat because of infantile ovaries, already mentioned as a cause of reproductive failure.

FAULTY MANAGEMENT PRACTICES

For a number of years the Animal Husbandry Department of the New York State College of Agriculture has used a mobile laboratory to investigate conditions in herds where breeding difficulties have been present on a large scale. Experience with this laboratory has shown that some form of management fault was involved in about 75 percent of the herds visited.

One-third of the herds were infected with *Vibrio fetus*. Leptospirosis was diagnosed in two herds and Brucellosis in one out of 65 herds visited. Disease is frequently spread by faulty management.

Among the faults of management that appear most frequently are the following:

1. Failure to recognize the signs of estrus so that cows are not bred, or are bred at the wrong time. This is especially true in winter when cows are in the barn. Because they come in heat at any time of day, the herd should be turned out twice a day and closely watched each time.

2. Breeding too soon after calving. If breeding is done earlier than 60 days after calving, the conception rate is lower and, if the cow does conceive, more trouble may occur in the ensuing pregnancy. It takes time for the bovine uterus to recover after parturition.

3. Failure to recognize the presence of an infertile bull in herds with more than one bull. Breeding records should be kept for the bulls as well as for the cows.

4. Changing bulls after a cow has failed to conceive to a first service. This practice aids in spreading a disease if one is present. There is clear proof of the spread of *Vibrio fetus* infection by this practice.

5. Failure to have regular pregnancy checks. Forty percent or more of the cows that are slaughtered because of sterility are with calf at the time they are slaughtered.

6. Failure to call a veterinarian soon enough when a cow is not breeding properly. Delay decreases the chance of rectifying the condition.

7. Failure to keep and use complete breeding records. A permanent lifetime record should be kept for each cow. In addition, a stable breeding chart and a heat expectancy chart should be kept in the barn where events can be recorded and checked easily.

How important is proper timing?

It hardly seems necessary to answer this question because so much emphasis has been placed on correct timing in artificial insemination work. A few words and a chart may be helpful to show how important it is. Timing means the time of service during the estrous cycle. The spermatozoa have a limited length of life in the female tract, only 24 hours or so, and the egg lives for only five or six hours. If sperms are deposited more than 24 hours before the eggs are shed, they may die

before fertilization can occur. Normally the heat period lasts about 18 hours and the egg is shed about 12 hours after the end of heat. The limits of successful breeding are set by these times. With the use of artificial insemination, it has become possible to extend the breeding time a little after the end of heat. These figures are all averages and vary from cow to cow and from heat period to heat period.

The average percentage of success in breeding at different times is given in figure 10. Service or artificial insemination at the beginning of heat is about 44 percent successful. It rises to 80 percent by mid-heat and remains

Figure 10. Cows in barnyard for heat checking. Cow standing to be mounted is in heat.

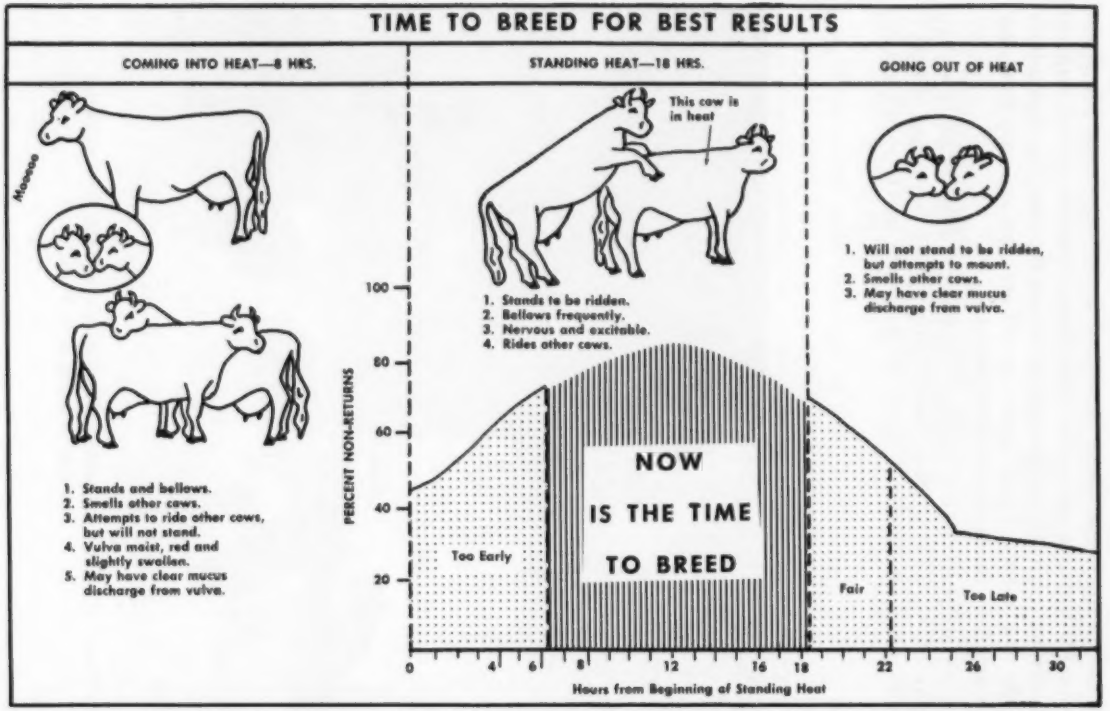

Figure 11. This chart shows the symptoms of heat shown during the three stages of the heat period. The graph shows the conception as intervals after the beginning of heat.

at almost that level until the end of heat. Four hours after the end it has dropped to about 60 percent and 12 hours after heat it has dropped to 32 percent. The decline is rapid after 18 hours, but apparently a few cows are so slow in ovulating that there is a slight chance of success until 48 hours after the end of heat. If artificial insemination is used, the inseminator should not be called until the cow is in standing heat.

Wait 60 days following calving to breed cows

The return of heat after calving occurs after a variable interval. Most cows come in heat for the first time between 41 and 60 days after calving. Trimberger and others have shown that when cows are bred earlier than 60 days after calving, the chance of success is lessened. If they do conceive, the ensuing pregnancy is more often a failure than are those started 60 days or longer after calving.

Fertile Cows Bred at Varying Intervals of Time Following Calving

Days after Calving	*Number of Cows*	*Percent Settled First Service*	*Services Required Per Conception*
50 or Less	26	31	2.5
51 to 60	24	67	1.7
*61 to 90	50	70	1.6
90 or More	50	76	1.5

*Recommended Time to Breed

The improvement in conception rate when cows are bred 60 days after calving is shown in the table above. The improved rate is probably the result of the recovery of the uterus during this time. Figures 12 through 15 show the progression of recovery of the uterus during this time.

Herd replacements and sterility

Experience has shown that the man who raises his own replacements has far less sterility in his herd than the one who buys replacements. A bought replacement may not be the best that the seller might offer. He may have had trouble with the cow before he decided to sell. While the replacement is being shipped, she may become exposed to all sorts of infection. One diseased cow may transmit her infection to many others and start a great amount of trouble. A farmer who has to buy replacements should deal with a reliable man, insist on blood tests, and refrain from using the herd sire on them until he is sure that it will not lead to trouble. Bred heifers are usually the best buy from this viewpoint.

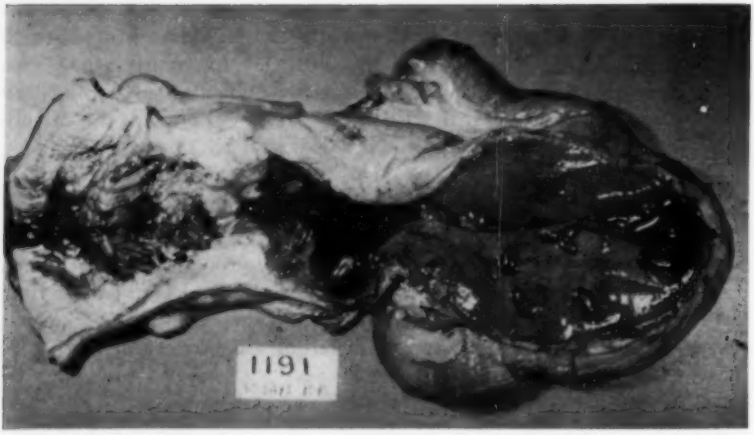

Figure 12. Reproductive organs from a cow 10 days after normal calving. Both horns are stretched out of shape and the caruncles (buttons) are still enlarged. Considerable bloody fluid still remains.

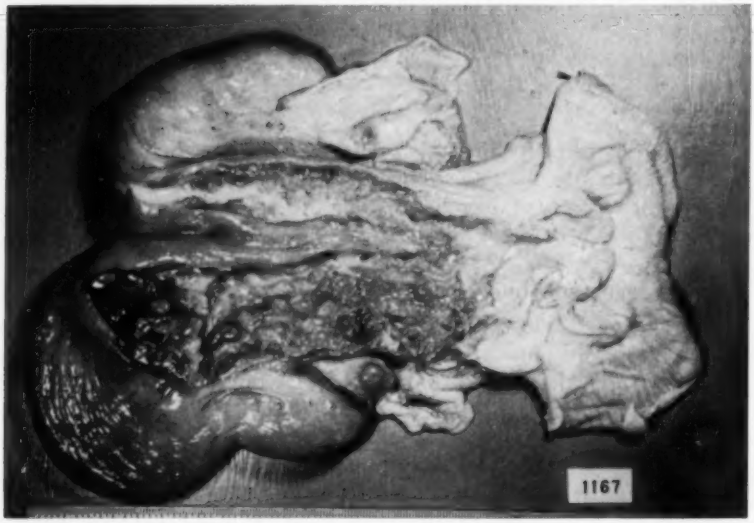

Figure 13. Reproductive organs from a cow 20 days after normal calving. The uterine horns are beginning to regain their shape but some pus is present in both of them.

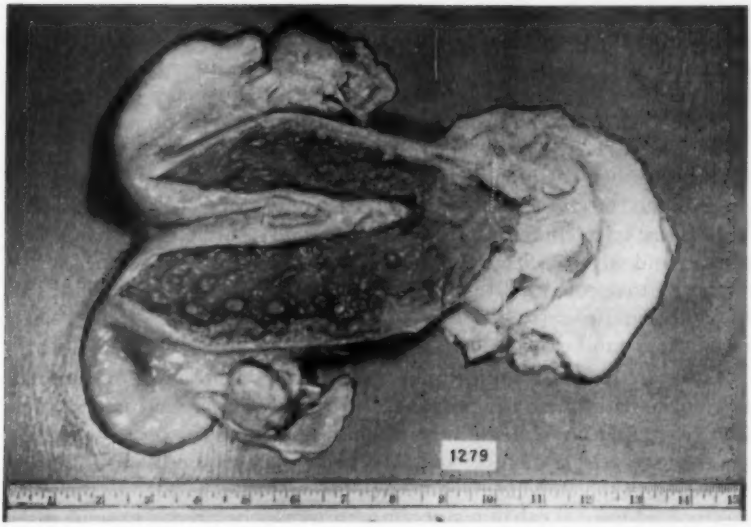

Figure 14. The reproductive organs of a cow 46 days after normal calving. Recovery is still not complete. The caruncles (buttons) are still prominent and the lower uterine horn is still larger than the other.

Nutrition and sterility

Whether nutrition affects breeding efficiency is one of the most debated questions. When all the obvious reasons for sterility have been considered and dismissed, there is a tendency to fall back upon faulty nutrition as the answer. A lack of vitamins or of minerals is blamed for the failure. As the question is usually put, one is asked whether any vitamin or mineral supplement may be used to improve breeding in a herd in which perhaps 10 or 20 percent of the cattle breed with difficulty. An honest answer is this: If the level *and* quality of feeding are average (that is, in accordance with recommended good feeding practice), the addition of minerals or of vitamins is of no help whatever. If the level *or* quality of feeding is inadequate, then the addition of certain minerals or vitamins that are short in the ration will certainly help. In such cases it is cheaper and better for the general health of the herd if feeding is made adequate. It has been found that both the amount and quality of the feed may be varied within very wide limits without impairment of reproduction.

Phosphorus deficiency has been found to cause some reproductive failures, but such cases are uncommon in New York. While pasture and

roughage may be low in phosphorus in certain soils, the feeding of grain mixtures (high protein feeds always have plenty of phosphorus) *should* take care of the deficiency, particularly if the grain mixture contains bone meal or dicalcium phosphate. Lack of calcium *may* contribute to reproductive troubles of animals in certain areas but probably not in New York. Calves may be born with a poor skeletal development as a result of either calcium or phosphorus deficiency, but any failure of reproduction itself is improbable. Much of the roughage grown in New York is low in calcium, but the feeding of bone meal helps to compensate for this and adverse effects are not in the reproductive organs. It has been suggested that cobalt and copper deficiencies cause breeding difficulties, but additional research is needed on these minerals before specific recommendations can be made.

There are several complex mineral and vitamin mixtures on the market, but none of these has proved to be beneficial as an aid to reproduction. A simple mineral mixture containing 50 percent dicalcium phosphate or steamed bone meal and 50 percent trace mineralized salt should be offered to the animals. Even though this material is added to the grain mixture, additional calcium and phosphorus may be needed in some cases.

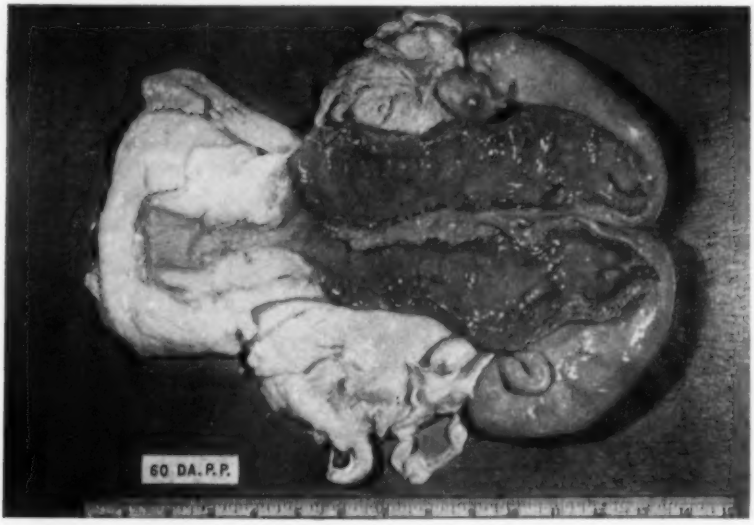

Figure 15. Reproductive organs from a cow 60 days after normal calving. The size, shape and color indicate that full recovery had taken place in this cow.

Experiments conducted at Cornell University have shown that sexual development can be retarded or speeded up by the level of nutrition in both heifers and bulls. Heifers were raised on three levels of nutrition: (1) medium level, 93 percent of Morrison's standards, (2) low level, 61 percent of the medium level and (3) high level, 129 percent of the medium level. The average age of first heat was 72, 49 and 37 weeks for the three groups, from low to high respectively. Bulls on similarly planned levels of nutrition produced viable semen at 51, 43 and 37 weeks of age for the low, medium and high levels respectively.[2]

IS A TENDENCY TO STERILITY INHERITED?

Certain forms of sterility caused by structural anomalies are definitely inherited. It is not nearly so clear, however, whether heredity influences the tendency to become sterile or relatively infertile. It would appear, also, that the tendency to sterility of a general, or unspecified, nature is inherited because it increased as the amount of inbreeding rose in certain families of cattle in experiments at the Illinois and California Experiment Stations. Sterility decreased in the offspring of those inbred cattle that had been out-crossed. There is also some evidence that the tendency toward cystic ovaries is inherited.

Recent statistical investigations have shown that disastrous as inherited sterility may be in certain cases, it forms but a small part of the overall sterility picture. Except in the rare instances of known inherited sterility it would not pay to select breeding stock for high fertility if selection for other more highly inherited factors were to suffer in the process.

One aspect of this problem is the presence of lethal factors that cause the embryo to develop abnormally so that it is not viable. Apparently these factors may cause death at any time in pregnancy or the calf may be carried for the usual time and be born dead. They are usually inherited as simple recessive factors which means that both parents have to be 'carriers' for the defect to kill the offspring. Among these 'lethals' may be mentioned mummified fetuses (not all the result of lethals), hydrocephaly, short spine, fused nostrils, and congenital dropsy. The existence of these genes is a strong argument against the indiscriminate use of inbreeding.

[2]For additional information on the effect of underfeeding and overfeeding on the growth and development of Holstein heifers and Holstein bulls refer to Cornell Experiment Station bulletins 936 and 940.

ARE HIGH-YIELDING COWS MORE LIABLE TO BREEDING TROUBLES THAN LOW-YIELDING COWS?

Some people assert that high milk yield is so great a drain on the cow that her reproductive functions suffer. On the other hand, lactation and reproduction are both under the control of one gland, the pituitary. If an exceptionally good pituitary gland produces an exceptionally good milk yield, it may be equally efficient in promoting reproduction. A fairly large body of information is now available on the question and it mainly supports the view that high yielding cows breed no better and no worse than their less profitable sisters. However, some recent research reported from Denmark does indicate that breeding efficiency decreases as the production level rises.

HOW OFTEN IS THE BULL AT FAULT WHEN A HERD HAS REPRODUCTIVE TROUBLE?

The bull is more important in reproductive failures than is generally realized. Experience in the use of bulls in New York artificial insemination work has shown that bulls differ widely in their capacity to get cows in calf promptly, and that individual bulls vary widely from time to time. These differences may sometimes be detected by an examination of the semen. A high proportion of dead sperm cells, many that are sluggish in motion and unable to survive for long, a high proportion of spermatozoa with abnormal shapes, and much bacterial contamination are all related to poor reproductive power as determined by the conception rate or number of inseminations needed to get a calf. Because a bull gets a few cows in calf does not mean that he is 100 percent fertile. The best measure of a bull's fertility level is the percentage of the cows bred to him that conceive to the first service when large numbers are bred.

The month by month variations in breeding efficiency of a bull are difficult to trace to particular causes. The process of sperm formation is complicated and it is easily thrown out of gear. A feverish condition, for instance, may easily have a bad effect. The "assembly line" that makes a spermatozoon takes about three weeks to do its job and then another three weeks may pass before the sperm is ejaculated in the semen. This means that a sudden fluctuation in the efficiency of a bull may be because of something that took place six weeks earlier.

In recent years work has been undertaken to uncover the precise ways in which highly fertile and moderately fertile bulls differ. In an experiment at Cornell University, semen from high fertility bulls fertilized 96

percent of the eggs, and 86 percent of a group of heifers bred to these bulls had normal calves in their uteri 33 days after they were bred. Semen from bulls of more moderate fertility, on the other hand, fertilized only 76 percent of the eggs and only 57 percent of the heifers slaughtered 33 days after breeding had normal calves. When normal cows are bred to highly fertile bulls, the primary loss is from early death of the fertilized eggs. It is not known to what extent the bull contributes to this failure. When normal cows are bred to low fertility bulls, however, the loss results about equally from nonfertilized eggs and from the death of some that were fertilized. The drop in fertilization rate is a fault of the bull in this case and he may also contribute to the higher death rate of the fertilized eggs.

HOW EFFICIENT MAY WE HOPE THE REPRODUCTIVE PROCESS TO BECOME?

If the tendency towards difficulty in breeding is inherited, though perhaps only to a slight extent, and if farmers preserve these shy breeders so that they transmit their inherited weakness, they can create more trouble for future generations. The tendency to inherit breeding weaknesses is so slight (except in cases of structural anomalies) that it may be neglected unless the cow belongs to a notoriously poor breeding family.

Another aspect of the question is more important. Can all, or nearly all, conceptions that are started be expected to carry to term and produce good calves? This is doubtful. Research has shown that of all the eggs shed at one heat period by animals such as sows, rabbits, and rats that bear litters, about one-third are lost or die before they reach the time for birth. The same thing is true for cows that have had a history of difficult breeding. It is about one half this high when normal cows are bred to high fertility bulls. Early deaths of eggs may be nature's way to get rid of bad eggs or bad sperm that should not come through to birth anyway. Possibly it is fortunate that the cow is not 100 percent efficient in her reproduction.

Many of the claims for the success of a given method of treatment for infertility fail to consider the number of spontaneous recoveries that may be expected; therefore, every recovery is credited, unjustifiably, to the treatment. One should discount extravagant claims for this or that treatment. The problem of infertility is a complex one and the causes varied. We cannot expect anything to qualify as a "cureall." There is still considerable room for improvement however, both in management practices and in the treatment of affected animals. This will follow as research reveals the causes and guidance in the prevention of breeding difficulties.

A FEW FINAL SUGGESTIONS

1. Feed calves wisely. Properly fed calves produce healthy cows. It is reasonable to suppose that healthy cows are less likely to break down than are unhealthy ones.

2. Keep good records that show dates of heats, dates of breeding, and dates of any unusual events such as unusual discharges or abortions. Such records help the veterinarian materially in making his diagnosis.

3. Wait at least 60 days after calving to re-breed cows.

4. Keep careful watch for heat periods. If one is missed and bleeding is noticed from the vulva, watch the cow carefully about 17 to 19 days later for a heat period; it is necessary to turn cows out at least once daily for this purpose. Cows expected in heat should be turned out a second time later in the day.

5. Do not breed a cow with an unnatural discharge; that is, one with discolored or flaky mucus.

6. Do not breed a cow that has not cleaned properly after calving until you are sure that she is clean.

7. Never allow other cows or livestock to touch the discharge and bedding of a cow that has aborted. The bedding should be burned or buried. Isolate the cow until you are sure that the abortion was not the result of a contagious or infectious disease.

8. Consult a veterinarian if a cow does not conceive to three services. Something probably is wrong.

9. Have a veterinarian check the breeding health of the herd at regular intervals. If he does this, he can pick up trouble in the early stages and effect cures. This is good practice and saves money in the long run.

10. Do not neglect the bulls in these routine checks.

11. Give the cows plenty of daylight and exercise. Both help to maintain reproductive health, especially in winter.

12. Do not use tonics unless they are advised by the veterinarian. These may act as stimulants when there is some underlying cause for poor breeding that should be corrected before breeding is allowed.

13. Before you discard a cow for sterility make sure that she is not in calf. It is surprising how many cows are sold as sterile when they are really in calf. A check at one abattoir in Wisconsin revealed that 60 percent of the cows brought in as sterile were in calf. This is exceptionally high but it illustrates the point.

14. If there is doubt about the infectious nature of an abortion or any other form of sterility, consult your local veterinarian or write the New

York State Veterinary College at Cornell University, Ithaca, New York. The College is ready and glad to do what it can to help. Staff members of the Department of Animal Husbandry also are glad to help when questions of feeding and management arise.

NOTES

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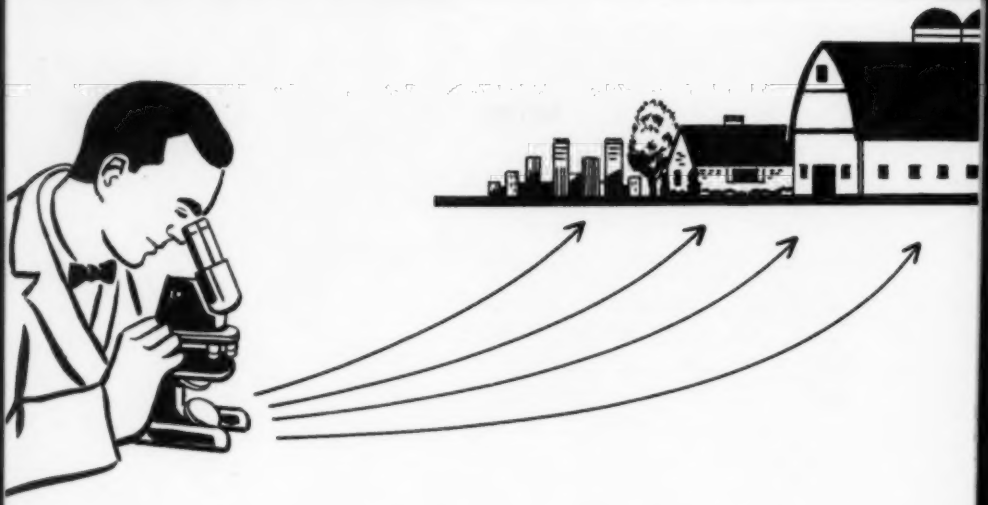

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